REMARKS

Each of claims 1 and 25 has been amended to recite that the adsorption medium comprises polyacrylonitrile ("PAN") and at least one metal hydroxide. Support for this amendment is found in the as-filed specification at at least paragraphs [0019], [0020], [0025], and [0026]. Claim 16 has been amended to improve the clarity of the claim. Claim 22 has been amended to recite that the PAN matrix comprises from approximately 15% by weight to approximately 90% by weight of the adsorption medium and the at least one metal hydroxide comprises from approximately 10% by weight to approximately 85% by weight of the adsorption medium. Support for this amendment is found in the as-filed specification at at least paragraphs [0025] and [0026]. No new matter has been added.

The Final Office Action mailed October 21, 2005, has been received and reviewed. Claims 1-16 and 22-27 are currently pending in the application. Claims 1-16 and 22-27 stand rejected. Applicants have amended claims 1, 16, 22, and 25 and respectfully request reconsideration of the application as amended herein.

35 U.S.C. § 103(a) Obviousness Rejections

Obviousness Rejection Based on U.S. Patent No. 6,232,265 to Bruening *et al.*

Claims 1-16 and 22-27 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,232,265 to Bruening *et al.* ("Bruening"). Applicants respectfully traverse this rejection, as hereinafter set forth.

M.P.E.P. 706.02(j) sets forth the standard for an obviousness rejection:

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

The obviousness rejection of claims 1-16 and 22-27 is improper because the cited reference does not teach or suggest all of the claim limitations and does not provide a motivation to produce the claimed invention.

Bruening teaches a composition of a particulate solid support that includes a hydroxypyridinone-containing ligand that is covalently bonded to a solid support by a hydrophilic hydrocarbon spacer. Bruening at column 3, line 49 through column 4, line 14. The composition of the particulate solid support is represented by the formula SS-A-X-L$(HOPO)_n$, where SS is a solid support, A is a covalent linker, X is a hydrophilic spacer group, L is a ligand carrier, HOPO is a hydroxypyridinone group, and n is an integer from 3-6. *Id.* The hydroxypyridinone-containing ligand includes three or more hydroxypyridinone ("HOPO") groups attached to the ligand carrier. *Id.* The ligand carrier is a noncyclic compound or an amine, such as a polyamine. *Id.* at column 4, lines 23-35. The solid support is an inorganic or polymeric organic material, such as silica, silica gel, silicate, zirconia, titania, alumina, nickel oxide, glass beads, phenolic resin, polystyrene, or polyacrylate. *Id.* at column 5, lines 8-12. The solid support is attached to the hydrophilic hydrocarbon spacer by a covalent linker. *Id.* at column 4, lines 8-14. The particulate solid support is used to selectively bind transition metal ions, post-transition metal ions, actinide metal ions, or lanthanide metal ions, from a source solution. *Id.* at column 6, lines 6-17.

Example 3 of Bruening teaches the preparation of tetrakis (5-amino-2-oxa-pentyl)methane as the ligand carrier, or "L," of the formula SS-A-X-L$(HOPO)_n$. *Id.* at column 8, line 22 and column 9, lines 12-67. Tetrakis (5-amino-2-oxa-pentyl)methane is synthesized from pentaerythritol and acrylonitrile using an Ag/KOH catalyst. *Id.* at column 9, lines 26-29. The pentaerythritol and acrylonitrile are reacted with stirring to produce a tetranitrile product and then are poured into water, allowing excess acrylonitrile to polymerize. *Id.* at column 9, lines 29-33. After removing the polymerized acrylonitrile by filtration, the reaction mixture is washed with chloroform. *Id.* at column 9, lines 33-34. The chloroform layer is washed with water, dried, and the chloroform removed to provide the tetranitrile product. *Id.* at column 9, lines 34-38. The tetranitrile product is further reacted to produce tetrakis (5-amino-2-oxa-pentyl)methane. *Id.* at column 9, lines 37-67.

As amended, claim 1 recites a method of producing an adsorption medium. The method comprises dissolving at least one metal compound in a solvent to form a metal solution, dissolving PAN into the metal solution to form a PAN-metal solution, and depositing the PAN-metal solution into a quenching bath to form an adsorption medium comprising PAN and at least one metal hydroxide.

Bruening does not teach or suggest all of the limitations of amended claim 1 because Bruening does not teach or suggest "dissolving polyacrylonitrile (PAN) into the metal solution to form a PAN-metal solution" and "depositing the PAN-metal solution into a quenching bath to form an adsorption medium comprising PAN and at least one metal hydroxide." The Examiner states that Example 3 of Bruening teaches or suggests the former limitation but appears to rely on the mere mention of polymerized acrylonitrile in Example 3 as teaching the above-mentioned limitation. Office Action of October 21, 2005, p. 2. Applicants respectfully disagree with the Examiner's statement. Example 3 teaches that pentaerythritol and acrylonitrile are reacted to form a tetranitrile product. Excess acrylonitrile remaining after the reaction is allowed to polymerize and is filtered from the reaction. While Bruening teaches that the acrylonitrile polymerizes, the polymerized acrylonitrile is not dissolved into a metal solution to form a PAN-metal solution. Rather, the polymerized acrylonitrile is removed by filtration, which implies that the acrylonitrile does not remain dissolved or in solution after it polymerizes. While polymerized acrylonitrile is mentioned in Example 3, the polymerized acrylonitrile is a by-product of one of the reactions that produces the tetrakis (5-amino-2-oxa-pentyl)methane. As such, Example 3 of Bruening does not teach or suggest the above-mentioned limitation.

The Examiner also asserts that Example 3 teaches "mixing the acrylonitrile to form a 'solution.'" Office Action of October 21, 2005, p. 4. However, the only teaching in Example 3 of a "solution" is a solution of the tetranitrile product. It is improper for the Examiner to characterize this as a solution of acrylonitrile because, at this stage, the acrylonitrile has been reacted with the pentaerythritol to form the tetranitrile product and any acrylonitrile that has polymerized has been removed by filtration. Bruening at column 9, lines 26-67. Furthermore, since claim 1 recites that PAN is dissolved, the presence of an acrylonitrile solution in Bruening does not teach or suggest the above-mentioned limitation of dissolving PAN into the metal

solution to form a PAN-metal solution.

The Examiner appears to argue that the mixture of pentaerythritol and acrylonitrile in Example 3 teaches or suggests this limitation. However, when the pentaerythritol and acrylonitrile are mixed and reacted to form the tetranitrile product, the acrylonitrile is in a non-polymerized or monomeric form. Since this acrylonitrile is not polymerized, it is improper for the Examiner to consider or characterize the acrylonitrile as polymerized acrylonitrile or PAN.

Example 3 of Bruening also does not teach or suggest the limitation of "depositing the PAN-metal solution into a quenching bath to form an adsorption medium comprising PAN and at least one metal hydroxide." While Bruening teaches pouring the mixture of pentaerythritol and acrylonitrile into water, this acrylonitrile is monomeric and is not polymerized. As such, it is improper for the Examiner to characterize this mixture as a PAN-metal solution that is deposited into a quenching bath. Furthermore, Bruening does not teach or suggest that depositing the mixture of pentaerythritol and acrylonitrile into a quenching bath forms an adsorption medium that comprises PAN and at least one metal hydroxide. Rather, the product formed in Example 3 of Bruening is tetrakis (5-amino-2-oxa-pentyl)methane, which is used as a ligand carrier in the particulate solid support of Bruening. While polymerized acrylonitrile is mentioned in Example 3, the polymerized acrylonitrile is a by-product of one of the reactions that produces the tetrakis (5-amino-2-oxa-pentyl)methane and is filtered from the reaction mixture. As such, Bruening does not teach or suggest that the polymerized acrylonitrile is part of its particulate solid support.

The Examiner states that "a recitation of the intended use of the claimed invention and the prior art must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art." Office Action of October 21, 2005, p. 4. Applicants respectfully submit that the above-mentioned limitation does not merely recite an intended use of the claimed invention. Rather, the limitation recites that the adsorption medium comprises PAN and at least one metal hydroxide. Since the particulate solid support of Bruening does not include PAN and at least one metal hydroxide, Bruening does not teach or suggest this limitation.

The Examiner acknowledges that Bruening does not teach or suggest the latter limitation but states that "[i]t would have been obvious to one of ordinary skill in the art at the time the

invention was made to deposit and form an adsorption medium because Bruening discloses particulate solid 'supports,' which would motivate depositing onto the disclosed support and also because Bruening discloses making a 'selectively binding' particulate composition, which would motivate forming an adsorption medium." Office Action of October 21, 2005, p. 2-3. However, this statement by the Examiner is conclusory and is not based on objective evidence of record. The Examiner appears to suggest that the mere presence of polymerized acrylonitrile in making the particulate solid support is sufficient to teach or suggest that the particulate solid support includes polymerized acrylonitrile. However, the Examiner overlooks the fact that the particulate solid support of Bruening does not include polymerized acrylonitrile. Rather, the polymerized acrylonitrile is a by-product of one of the reactions and is removed in the process of making the particulate solid support.

Since the cited reference does not teach or suggest all of the limitations of claim 1 and does not provide a motivation to produce the claimed invention, the obviousness rejection of claim 1 is improper and should be withdrawn.

Claims 2-16 are allowable, *inter alia*, as depending on an allowable base claim.

Claim 7 is further allowable because Bruening does not teach or suggest dissolving the at least one metal compound in concentrated nitric acid. The Examiner states that Bruening teaches this limitation because Bruening teaches nitric acid. Office Action of October 21, 2005, p. 3. However, the mere mention of nitric acid in Bruening does not teach or suggest this limitation because the aqueous nitric acid in Bruening is taught to be a receiving liquid for eluting desired metal ions from a column that contains the particulate solid support of Bruening. Therefore, while Bruening teaches using nitric acid, Bruening does not teach or suggest that the nitric acid is used to dissolve at least one metal compound, as recited in claim 7.

Claim 8 is further allowable because Bruening does not teach or suggest dissolving an amount of the at least one metal compound sufficient to produce the metal solution saturated with the at least one metal compound.

Claim 9 is further allowable because Bruening does not teach or suggest dissolving from approximately 3% by weight to approximately 5% by weight of PAN into the metal solution. Since Bruening does not teach or suggest dissolving PAN into a metal solution, for the reasons

described above for claim 1, Bruening necessarily does not teach or suggest dissolving the recited percentages of PAN into a metal solution.

Claim 10 is further allowable because Bruening does not teach or suggest spraying the PAN-metal solution into a quenching bath that includes an alkaline agent to form the adsorption medium. Since Bruening does not teach or suggest dissolving PAN into a metal solution, for the reasons described above for claim 1, Bruening necessarily does not teach or suggest spraying such a PAN-metal solution into a quenching bath that includes an alkaline agent.

Claim 11 is further allowable because Bruening does not teach or suggest spraying the PAN-metal solution into a quenching bath that comprises from approximately 0.1M sodium hydroxide to approximately 8M sodium hydroxide to form the adsorption medium. Since Bruening does not teach or suggest dissolving PAN into a metal solution, for the reasons described above for claim 1, Bruening necessarily does not teach or suggest spraying such a PAN-metal solution into a quenching bath that comprises sodium hydroxide at the recited concentrations.

Claim 12 is further allowable because Bruening does not teach or suggest simultaneously precipitating at least one metal hydroxide from the PAN-metal solution and insolubilizing the PAN in the PAN-metal solution. Since Bruening does not teach or suggest forming a PAN-metal solution, for the reasons described above for claim 1, Bruening necessarily does teach or suggest that at least one metal hydroxide is precipitated from the PAN-metal solution as the PAN in the PAN-metal solution is insolubilized.

Claim 13 is further allowable because Bruening does not teach or suggest producing a solid bead comprising at least one metal hydroxide incorporated into the PAN. As previously discussed, the particulate solid support of Bruening does not include PAN.

Claim 15 is further allowable because Bruening does not teach or suggest impregnating a support with at least one metal hydroxide incorporated into the PAN. Since the particulate solid support of Bruening does not include PAN, Bruening necessarily does not teach or suggest impregnating a support with at least one metal hydroxide incorporated into the PAN.

Claim 16 is further allowable because Bruening does not teach or suggest producing an adsorption medium having from approximately 10% by weight to approximately 85% by weight

of a metal in the form of an elemental metal or the at least one metal hydroxide and from approximately 15% by weight to approximately 90% by weight of the PAN because the particulate solid support of Bruening does not include PAN.

Claim 22, as amended, recites an adsorption medium having an increased metal loading. The adsorption medium comprises a PAN matrix and at least one metal hydroxide. The PAN matrix comprises from approximately 15% by weight to approximately 90% by weight of the adsorption medium and the at least one metal hydroxide comprises from approximately 10% by weight to approximately 85% by weight of the adsorption medium.

Bruening does not teach or suggest all of the limitations of claim 22 because Bruening does not teach or suggest that its particulate solid support includes a PAN matrix and at least one metal hydroxide. As previously explained, while Bruening teaches that polymerized polyacrylonitrile is produced as a by-product of one of the reactions described in Example 3, the polymerized polyacrylonitrile is not present in the resulting particulate solid support. Rather, the polymerized polyacrylonitrile is removed from the reaction mixture that ultimately becomes the tetrakis (5-amino-2-oxa-pentyl)methane ligand carrier of the particulate solid support. As such, the particulate solid support of Bruening does not include PAN. Since Bruening does not teach or suggest that its particulate solid support includes a PAN matrix and at least one metal hydroxide, Bruening necessarily does not teach or suggest the recited percentages of the PAN matrix and the metal hydroxide.

The Examiner states that this limitation of claim 22 is taught because "Bruening '265 discloses 42.45g polymerized acrylonitrile." Office Action of October 21, 2005, p. 3. Applicants respectfully disagree with this statement and submit that it mischaracterizes the teachings of Bruening. The Examiner's statement seems to suggest that the mere mention of polymerized acrylonitrile in the process of making the particulate solid support of Bruening is sufficient to teach or suggest this limitation. However, since claim 22 recites that the adsorption medium comprises the PAN matrix and the at least one metal hydroxide, the polymerized acrylonitrile must be present in the particulate solid support of Bruening in order for the Examiner's statement to be true. However, in Example 3, 42.45 g of acrylonitrile, not polymerized acrylonitrile or PAN, is present. The acrylonitrile reacts with pentaerythritol to form a tetranitrile product while

excess acrylonitrile is polymerized and removed from the reaction mixture as an undesirable by-product. Since the polymerized acrylonitrile is removed from the reaction mixture used to make the particulate solid support, the particulate solid support of Bruening does not include PAN.

Claims 23 and 24 are allowable, *inter alia*, as depending on an allowable base claim.

Claim 23 is further allowable because Bruening does not teach or suggest that its particulate solid support comprises at least approximately 50 wt% of the metal in the form of an elemental metal or the metal hydroxide.

Claim 24 is further allowable because Bruening does not teach or suggest that its particulate solid support comprises at least one metal hydroxide substantially homogenously dispersed in the polyacrylonitrile matrix.

As amended, claim 25 recites limitations that are similar to those recited in claim 1. Specifically, claim 25 recites the limitations of "dissolving polyacrylonitrile (PAN) in an organic solvent to form a PAN solution" and "depositing the metal oxide-PAN solution into a quenching bath to form an adsorption medium comprising PAN and at least one metal hydroxide." In regard to the former limitation, Bruening does not teach or suggest this limitation because Bruening does not teach or suggest dissolving PAN in an organic solvent to form a PAN solution. While polymerized acrylonitrile is formed in Bruening as a by-product, the polymerized acrylonitrile is removed by filtration, which implies that the polymerized acrylonitrile is not dissolved or in solution. In regard to the latter limitation, Bruening does not teach or suggest this limitation for the same reasons as discussed above for claim 1.

Since the cited reference does not teach or suggest all of the limitations of claim 25, the obviousness rejection of this claim is improper and should be withdrawn.

Claims 26 and 27 are allowable, *inter alia*, as depending on an allowable base claim.

Claim 26 is further allowable because Bruening does not teach or suggest adding at least one powdered metal oxide to the PAN solution. Since Bruening does not teach or suggest a PAN solution, for the reasons described above, Bruening necessarily does not teach or suggest this limitation.

Claim 27 is further allowable because Bruening does not teach or suggest depositing the metal oxide-PAN solution into a water bath to form the adsorption medium. Since Bruening

does not teach or suggest a PAN solution, for the reasons described above, Bruening necessarily does not teach or suggest this limitation.

ENTRY OF AMENDMENTS

The amendments to claims 1, 16, 22, and 25 should be entered by the Examiner because the amendments are supported by the as-filed specification and drawings and do not add new matter to the application.

CONCLUSION

Claims 1-16 and 22-27 are believed to be in condition for allowance and an early notice thereof is respectfully solicited. Should the Examiner determine that additional issues remain that might be resolved by a telephone conference, the Examiner is respectfully invited to contact Applicants' undersigned attorney.

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